Chapter 18

Harvesting Data Big Data Analytics in AgTech

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Abstract

Smart farming leverages cutting-edge technologies like cloud computing and the Internet of Things (IoT) to incorporate technology into farm management. Farming operations make decisions based on Big Data, comprised of an enormous amount of data from various sources. Innovative agricultural technologies are transforming farming techniques and sustainability. Some of these technologies includes virtual and augmented reality, IoT, robotics, Artificial Intelligence (AI), Big Data, and automation. These innovations power precision agriculture, which maximizes the utilization of available resources and makes advantage of an array of data from everyday activities to boost crop output and performance. The paper explores the sensors and data analytics techniques that are now employed across various agricultural fields, highlighting how data analytics has transformed agriculture from an input-intensive to a knowledge-intensive sector. The agricultural industry is transitioning from depending exclusively on wireless sensor networks to a more integrated approach by leveraging IoT and data analytics to boost operational efficiency and productivity. A multifaceted strategy designed for strengthening agricultural output, revenue, responsive capacities, and greenhouse gas emission mitigation, known as climate-smart agriculture (CSA), is gaining momentum because to the integration of big data analytics and climate change science. IoT technology breakthroughs are redefining "smart agriculture," transforming conventional statistical techniques into quantitative approaches. This article explores the prospects and problems of integrating wireless sensors and the IoT with traditional methods of farming to explore the potential of these technologies in agriculture.

Keywords

Agr-Itech, Agricultural Informatics, Climate-Smart Agriculture, Data Analytics, Sustainable Farming

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1. Introduction

Smart farming is a revolutionary approach that combines technology, such as cloud computing and the Internet of Things (IoT), with innovations like robots and artificial intelligence (AI), as well as the utilization of big data to make intelligent choices [1]. Smart farming maximizes agricultural productivity and sustainability employing data-driven methods. It lowers the hazards of environmental degradation and resource depletion by utilizing sensor outcomes. AI and robotics further promote this sustainable agriculture of the future [2]. Robots, drones, and machine learning are a few examples of the technological innovations that are transforming agriculture and increasing productivity while optimizing harvests. The profitability and sustainability of agriculture in the future are being shaped by these technologies [3]. IoT technologies are revolutionizing traditional processes in the agriculture sector by making it more data-driven, accurate, and innovative. Utilizing IoT devices, and wireless sensors in agricultural applications, for establishing specific tasks like crop monitoring, irrigation control, soil preparation, and pest detection [4]. The agricultural industry is transitioning from a statistical to a qualitative perspective by adopting an IoT-based, data-driven, and technologically sophisticated approach [5]. Aiming to fulfill the demands of a growing global population and addressing issues related to farming, the emergence of IoT, UAVs, the Internet of Underground Things (IoUT), and data analytics in agriculture is revolutionizing productivity and farming practices [6]. Important farming cycles that impact farmers' profits are harvesting and post-harvesting. The study results indicate that reducing losses and improving outcomes can be achieved through the implementation of auto-harvesting robots, Machine Learning, and Deep Learning approaches [7].

2. Big Data Analytics in Agritech

By combining Industry 4.0 (I4.0) technologies such as IoT, Smart Distributed Ledger Technology (DLT), and Big Data Analytics with agricultural output, Agri-tech Business 4.0 promotes decentralization, communication, transparency, and food security [8]. Sustainable farming practices are experiencing a revolution by emerging agricultural technologies such as Big Data, AI, robotics, IoT, and virtual reality. Precision agriculture is the result of these developments, which promote crop production and maximize resource utilization [9]. Ecosystems depend on regulating inefficiencies to maintain data integrity, however agri-tech services augment the value of data. Data supply, stakeholder involvement, and platform sustainability are under risk due to emerging technologies that change the value of data sharing [10]. Agricultural informatics, especially Big Data and Analytics, which efficiently manage enormous data sets while providing prominence to new terminologies, has been significantly affected by technological breakthroughs such as Data Analytics, AI, Cloud Computing, and IoT [11]. ICT and sensors in agriculture strengthen the value chain and productivity. Knowledge-driven agriculture is powered by data analytics, which store, share, and analyze enormous amounts of data to provide valuable insights [12]. Food security issues are being addressed by the way the world's population is changing agriculture. Productivity and operational efficiency are being enhanced with IoT and data analytics technology. IoT transforms agriculture by integrating multiple technologies, including radio frequency identification, cloud computing, middleware systems, and WSN [13]. Agri-Tech technology is revolutionizing resource allocation, monitoring, and collecting in a significant manner for the industry. Robotics and machine learning are improving yields and productivity, while IoT is transforming operations. Robotics and IoT both minimize the need for agricultural chemicals. Farmers and consumers gain from machine learning's capacity for predictive analysis and industrial process optimization [14]. Real-time weather forecasts,

Figure 1. Agricultural Drones and Robotics

disease diagnosis, optimal fertilizer application, drone surveillance, and AI powered analytics are just a few of the means that smart agriculture leverages technology to boost farmers' practices. It offers prescriptive recommendations for crop cultivation and soil condition, minimizes the need for fertilizer application, and makes tasks like weed detection better [15]. Climate-smart agriculture (CSA) can be expedited by big data analytics and climate change research, which will boost agricultural production, incomes, and flexibility. This comprehensive strategy, with a focus on the farm, minimizes greenhouse gas emissions by using data-centric, knowledge-driven decision-making [16]. Precision agriculture employs data-centric technologies to address the concern of food insecurity attributed to climate change. Agritech firms maintain the practice of agrarian surveillance capitalism by collecting information and swaying farmer decisions through the management of growth and natural decline [17]. Figure 1 shows how agricultural drones and agri-robotics can revolutionize the current farming practices, these devices can help in monitoring, spraying, data capturing, and various other farming operations.

3. Recommendations

After thorough literature review on the technologies that are currently being employed in the agriculture domain, we propose following recommendations.

- Adoption of digital farming is crucial for sustaining financial viability and satisfying the demands of an expanding population. While intuition-driven management without data will no longer be the norm, larger farms will invest in state-of-the-art machinery.
- By facilitating information sharing, shared data storage, and improved communication between farmers and agricultural specialists, IoT technology could enhance collaborative farming in rural areas.
- By giving comprehensive guidance and insights for decision-making, machine learning is turning farm management systems into artificial intelligence and improving production results. It is anticipated that use will grow in the future, creating valuable agricultural equipments.
- The Agri-Food industry requires continuous strategy refinement through the analysis of previous businesses, networks, and start-ups efforts in order to attain long-term sustainability.

- The survey of literature shows that there are lots of work ongoing in development of IoT technology that can be used to increase operational efficiency and productivity of plant and livestock.
- Digitization of agriculture minimizes costs, facilitates communication, and influences the farming and food industries. It strengthens food safety procedures by promoting predictability, regulatory control, and remote operations.
- Real-time data is made available to farmers by IoT and smart sensor technology, facilitating data analytics for critical forecasts, crop scheduling, disease risk evaluation, and yield estimates.

Conclusion

Agriculture is being modernized by the integration of communication technologies, including smartphones, IoT, and AI. These technologies are addressing concerns including population growth, limited resources, and climate change. This article explores how sensors and data analytics are employed in agriculture, emphasizing the development of IoTs and AI-based applications with a strong research focus. According to the study, standardized farm information facilitates the most effective decision-making process, while agricultural management systems utilizing robotics and artificial intelligence offer tailored remedies. In order to fulfill the growing need for food, more intelligent crop cultivation methods must be developed. The younger generation who are tech-savvy are getting into farming in order to eventually become fossil fuel independent. Safety precautions, nutrition labeling, and growth tracking are all experiencing rises in popularity. A vision of connected, tailored, data-driven, and climate-smart agriculture could emerge from the integration of sophisticated data sciences, technologies, and integrated agricultural systems.

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